

also devised a flame collector for use in cold weather, as described on pages 128 and 129 of the same report.

In 1889 Mr. Morrill was delegated to represent the Signal Service at the Exposition Universelle at Paris, and his report on this subject, as published on pages 683-686 of the Annual Report of the Chief Signal Officer for 1890, shows his familiarity with physical apparatus.

In connection with his duties as Forecast Official, the question of the reduction of barometric measurements to sea level, for the purpose of drawing daily isobars, attracted his attention; the problem of a reduction appropriate to both mountains, and plateaus, and lowlands has always been a troublesome one, and yet vitally important for the United States. Mr. Morrill's review of the whole subject was thorough and excellent, and his resulting system or method seems to be a decided advance over any previously devised. He applied it also to annual charts as published in the MONTHLY WEATHER REVIEW for 1895, 1896, 1897, and it is now being applied also to the monthly isobars on Chart IV of the current REVIEW. He also constructed the isobars for higher levels, as published in the annual summaries for these years.

The current work on the prediction of floods in rivers was assigned to Mr. Morrill after the retirement of Prof. Thomas Russell, and this gave occasion for his monthly publication of summaries in the MONTHLY WEATHER REVIEW, as also the preparation of several annual volumes of daily rainfall and heights of rivers. His last work on the floods of the Mississippi is as creditable to him as it is to the Service.

DESTRUCTION BY LIGHTNING IN THE STATE OF NEW YORK DURING THE MONTH OF AUGUST, 1898.

By ROBERT G. ALLEN, Section Director.

The month of August was remarkable for the almost daily occurrence of thunderstorms and for the violence and frequency of destructive lightning. The oldest citizens, who reported during July unprecedented losses by lightning, now report that the damage of this description during the month of August was far in excess of that reported in July, and that the storms on the 16th, 23d, and 24th were the most severe ever witnessed in this State.

The storms of the 23d were most violent in southeastern New York and in the upper Hudson Valley. The storms of the 24th were most severe through the eastern highlands and in the counties bordering on Lake Ontario.

Fourteen persons are reported to have been killed during the month; these reports are incomplete, and it is most probable that those instances reported are less than 50 per cent of the number of persons killed. Thunderstorms occurred on every day in the month, excepting the 11th and 20th, and destructive lightning occurred on the 1st, 2d, 3d, 4th, 5th, 7th, 8th, 9th, 12th, 14th, 15th, 16th, 17th, 18th, 22d, 24th, 25th, 26th, 29th, and 30th.

The storms of the 16th and 23d were more extensive and far more violent than those on any of the other dates mentioned, as will be seen by reference to the losses on the different dates given below.

It is probable that the losses reported herein are much less than the actual amount of such damages, as it has been almost impossible to obtain the information from all the localities visited by the severe electrical storms. It may be interesting to know that not one of the burned or injured buildings was provided with lightning rods, and that about 50 per cent of the buildings struck by lightning were located on dry upland. A majority of the barns burned contained the season's crops.

The difference between the number of barns burned (96) and the valuation of the property destroyed (\$120,524) and

the number of dwellings burned or injured (29) and the amount of damage (\$3,276) is worthy of notice.

The following is a record of barns and houses burned or injured and the value of live stock killed during the month of August:

- August 1.—One dwelling slightly injured.
- August 2.—One residence, damage \$18.
- August 3.—Eight barns, \$5,405; 1 dwelling, \$1,900; stock killed, \$260.
- August 4.—Three barns, \$4,650; 1 dwelling, \$80; stock killed, \$95.
- August 5.—One barn, \$600.
- August 7.—One barn, \$450.
- August 8.—One church, \$30.
- August 9.—Stock, \$35.
- August 12.—Two dwellings, \$313.
- August 14.—One dwelling, \$89.
- August 15.—One barn, \$1,000.
- August 16.—Twenty-two barns, \$21,160; 2 residences, \$21; stock, \$150.
- August 17.—Thirteen barns, \$18,520.
- August 18.—One dwelling, \$8.
- August 22.—One barn, \$850.
- August 23.—Twenty-three barns, \$42,908; 14 dwellings, \$531; stock, \$939.
- August 24.—Sixteen barns, \$16,976; 5 residences, \$215; stock, \$455.
- August 25.—Stock, \$17.
- August 26.—One barn, \$900.
- August 29.—Five barns, \$6,499; 1 residence, \$100; electric car injured, \$150, and 1 wheat straw stack burned, \$40.
- August 30.—One barn, \$1,200.

Total number of barns burned or injured, 96; amount of damage, \$120,524. Total number of dwellings burned or injured, 29; amount of damages, \$3,276. Total value of stock killed by lightning, \$2,060. One church struck and damaged to the extent of \$30. One electric street car injured to the extent of \$150. One wheat straw stack burned, value, \$40. Total amount of all damages reported during the month of August, 1898, \$126,081.

[The above list is accompanied by a map of the State of New York showing every locality where lightning struck during August. Not having the necessary blank maps for New York the Editor can not publish Mr. Allen's map in detail, but several features may be mentioned.

1. In general no records of lightning strokes can be expected from regions that are sparsely inhabited, therefore none are reported from the Adirondack region, and in fact but six from the whole northeastern third of the State of New York.

2. A belt of special frequency extends from Niagara Falls directly eastward to Albany. This evidently marks the rich farming track traversed by the New York Central Railroad and the canal. An area of special frequency occurs in the southeastern portion of the State, principally in Orange, Ulster, and Dutchess counties.

3. In general the distribution of strokes over two-thirds of the State is so uniform as to lead one to believe that the same distribution would prevail over the northern third, if there were enough observers there present to take cognizance of them.

4. In general it is not the number of voluntary observing stations that controls the completeness of our records of lightning strokes, but the number of farmers with their dwellings and barns, and the activity of the local press reporters.

5. The special frequency of strokes in any small portion

of the State is due not to the general frequency of thunderstorms in that region, but to the occurrence of some one specially severe storm.

6. Mr. Allen gives no data by which one can estimate the relative safety of buildings with and without lightning rods, as every one of those injured had no lightning rod. Some years ago several of our American firms manufacturing lightning rods, in their replies to the circulars of the Lightning Rod Conference, stated that no buildings protected by their rods had ever been injured. Doubtless this was an exaggera-

tion, and yet the general conclusion to which that conference arrived still holds good, i. e., that injuries are inflicted only when the lightning rod is imperfect. If it be properly made and placed in the proper position, and in perfect electrical connection with the earth, and be terminated at the top with fine points, then the edifice protected by it with all that it contains will be safe. All accidents may be said to be due to a neglect of these simple elementary principles; "there is no authentic case on record where a properly constructed conductor failed to do its duty."—Ed.]

NOTES BY THE EDITOR.

BALL LIGHTNING.

The Editor has received the two letters following from Mr. C. N. Crotsenburg, Crow Agency, Montana, dated August 22 and September 6, 1898, respectively, and submits his own suggested explanation, but thinks it worth while to publish the whole in full, in order that the attention of others may be drawn to the subject, since, if his own explanation is correct, the phenomenon must be frequently seen by others:

As you expressed a desire to hear from those who had observed "ball lightning" at various times, I will relate an experience which befell me in the summer of 1896. I was then employed as a railway postal clerk on the line of the Chicago, Rock Island and Pacific Railway, between Davenport, Iowa, and Leavenworth, Kans.

One very dark night, about the middle of the summer, our train was going northward between Trenton, Mo., and Lineville, Iowa. Just before reaching Princeton, in Mercer County, a heavy rain began falling, which necessitated the closing of the doors on the east side of the mail car. Soon after leaving that station, at 10:35 p. m., my companion (Mr. R. C. Corbin) lay down for a short sleep. The work being very light that night, I sat in a chair, looking out of the car door to the west. The darkness was intense; not a ray of light was visible from any point, except from the train. When a few miles out from Princeton, and while traveling almost due north, I observed a peculiar light low down on the western horizon. It appeared to be perfectly round and about a foot in diameter, of a dull rose color, or, possibly, like a piece of live coal. When first observed it seemed to be floating within a hundred feet of the earth, but soon rose to a height about midway between the horizon and the zenith. For a time it floated very steadily, but soon began to oscillate up and down, at times even dropping out of sight behind hills. The wind was quite strong from the east, but the light traveled in an almost true north course. Its speed varied, sometimes seeming to outrun the train considerably, and at others it would fall behind, but never far enough to be lost to sight. Most of the time it appeared to be nearly abreast of the train and apparently from half a mile to a mile distant. Soon after it was first observed by me, my companion arose, and we both watched it closely until the town of Lineville, Iowa, was reached. There it passed out of sight behind the depot, and we saw it no more. During all the time it was in sight there was a heavy fall of rain, but very little lightning. It seemed to follow a course parallel to the Grand River, moving upstream. We had no idea at the time what caused the light, but I have since become convinced that it was "ball lightning."

Replying to your letter of August 30, and referring to my own of August 22: I have no means of ascertaining the date of the occurrence related. It made a very deep impression upon me at the time, and Mr. Corbin and myself often talked about it afterward, but I made no note of the date. We made many inquiries concerning the phenomenon which we observed, but never obtained a satisfactory explanation. We thought of distant electric light, but found that none existed within the range of our vision on that portion of the road. Since beginning this I remember that we remarked that if it had occurred a few nights before we should have felt certain that it was the light from a balloon sent up from some Fourth of July celebration, so probably it was within a week of July 4, 1896.

But even then, it would have been remarkable, as the light traveled almost directly north and kept an even course, while the wind blew quite strongly from the east. It was so very strange that I should never have mentioned it, even to my friends, had it not been corroborated by a reliable witness. I have sought for an explanation whenever and wherever I have had an opportunity, and from what I have been able to learn I had come to the conclusion that it was most probably "ball lightning."

Although my conclusions may be entirely erroneous, I have no more plausible theory to advance.

The fact that it was observed by both of us at the same time, and had the same appearance to his eyes as it had to mine before he saw it is very good evidence that it was a reality and not an hallucination. He observed it as he was passing the open door, and before I had spoken to him. In fact the thing was so unreal that I hesitated to speak of it, fearing that it was some freak of my imagination, but when he too saw it the same, I could no longer doubt its existence as a reality, and we both observed it closely while the train was running at least 15 miles. When it disappeared it was at least a mile from us, as the buildings of the town were plainly visible and it was some distance farther west than any of them.

There has always been a great deal of doubt as to whether the phenomenon known as "ball lightning" might not in some way be an optical delusion. The phenomenon rarely occurs, and it is therefore rarely seen by experienced electricians, and the latter were therefore justly skeptical. But within the past twenty years, so many instances have been recorded, some of them by observers of undoubted ability, that there can be no doubt but what this form of electrical discharge can exist, although at present we have no idea of its relation to the other forms of electricity. The following instances are recorded in the famous report of the lightning rod conference, compiled by ten or twelve members of prominent scientific organizations in England, edited by the well-known meteorologist G. J. Symons, and published in 1882:

Page 99. Near Strasburg, Germany, a discharge of globular lightning traversed a horizontal distance of 919 yards, passing below the top of a building which had three good conductors upon it, and struck a distant chestnut tree.

Page 205. D. Morgan, Master of the bark Southern Queen, on December 30, 1879, in the midst of a terrific squall, saw a ball of fire descend from the mizen and go over the port side of the vessel.

Page 242. Prof. P. G. Tait, of Edinburgh, says that fire ball or globe lightning undoubtedly exists, and is probably due to a species of natural leyden jar very highly charged, which no lightning rod can destroy, except perhaps a close net work of stout copper wires.

The preceding account of a phenomenon by Messrs. Crotsenburg and Corbin does not harmonize with the ordinary descriptions of ball lightning well enough to justify applying that term to it, and the editor believes that some other explanation of the phenomenon must be found. If there were a mass of falling rain, or fog, or haze at a little distance west of the train in which they were traveling, or in fact if there were groves or forests, the leaves of which were covered with rain drops, these would undoubtedly send back to the observer's eye a faint reflection or more properly an antisolar corona, which would be barely visible on a dark night. It would necessarily appear to float along with the train, as the Crotsenburg phenomenon did. There can be no doubt but what the light observed in this case was some form of reflection of the light of the train itself, as it certainly had none of the characteristics of ball lightning.

THE MEASUREMENT OF THE WIND.

The velocity of the wind is usually measured by means of some form of windmill apparatus, such as the Robinson anemometer.